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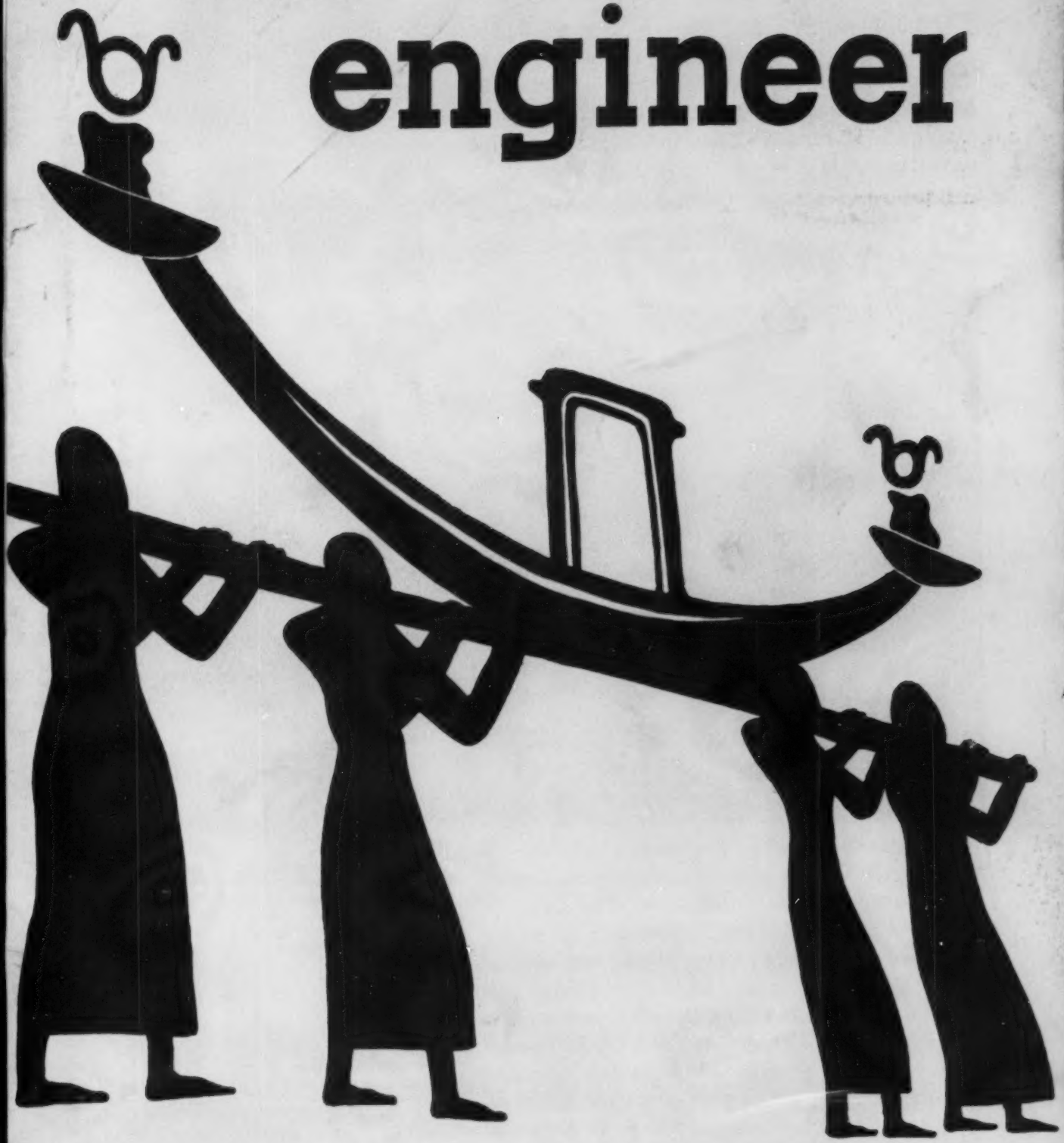

MAY, 1961
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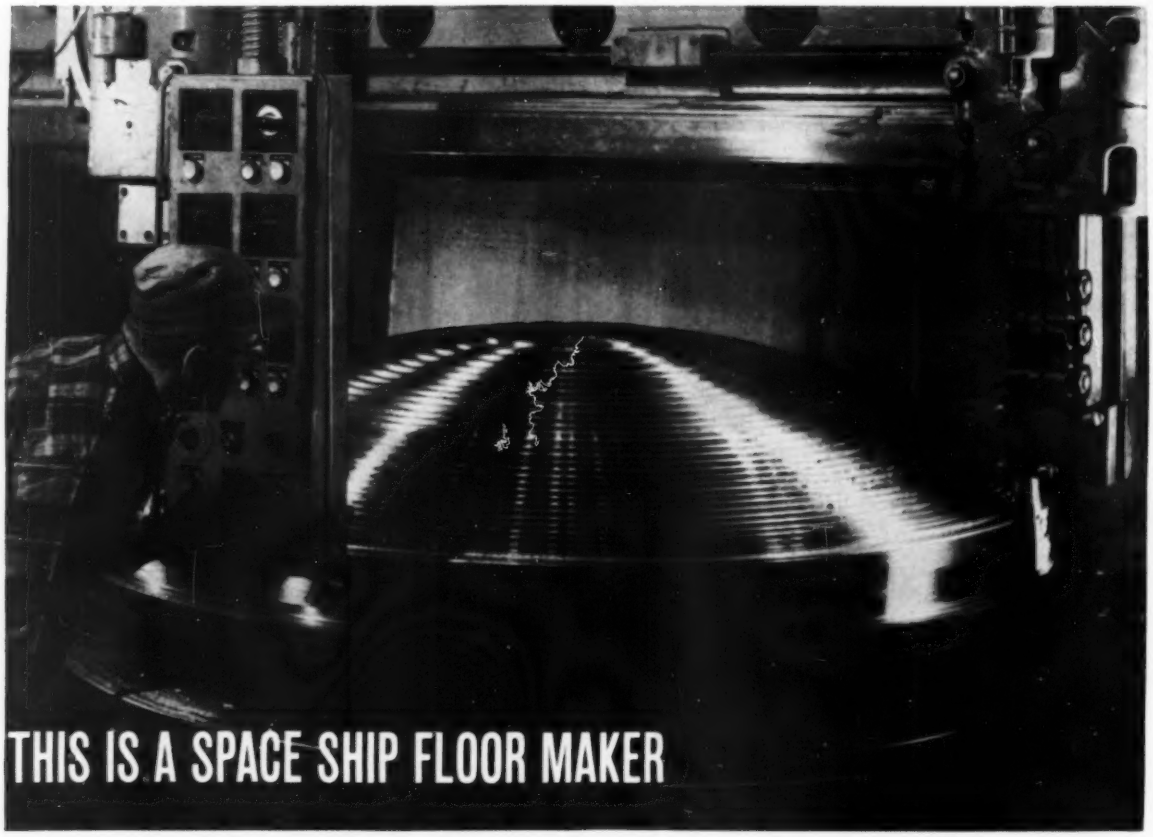

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Editorial . . .

ENGINEERS' DAY 1961

Although this issue must go to press before Engineers' Day, several confident predictions can still be made:

1. The exhibits will be good, will serve their purpose of increasing the viewers' interest in engineering at Cornell, and will be the result of much time and effort.
2. This time and effort will be put in by a very small number of students, driven by an even smaller number of devoted individuals who expected more cooperation from the student body than they received, and put in more time than they had expected.

This perennial situation is a difficult one to justify. Work on an E-Day committee is interesting and creative. Few who have participated in this work have regretted it. The opportunity for individual expression is present in a very real fashion. Demonstrating and explaining one's field of engineering to others is a task that requires imagination. These qualities are not usually present in classroom work. They can certainly be developed in an extracurricular activity such as E-Day. Why more students do not wish to become involved is difficult to say. Perhaps part of the difficulty lies in the purpose of the program. Presently Engineers' Day is aimed at the high school students who are invited to Cornell for the weekend and are supposedly attracted by the exhibits to study at the University. Although this is a worthwhile idea, it is evidently a distant one to many present engineering students. Something of more immediate concern to the student body would be a program aimed at present Cornell students. Perhaps an attempt to acquaint the non-engineers on campus with the engineering field would have a better reception. The recruitment needs of the college would still be served by such a program. The displays involved need not be much different from the ones planned for this year. What would be different is the emphasis. The engineering campus is now physically separate from the Arts and Agriculture Quadrangles. If Engineers' Day were thought of as an "Open House on the Engineering Quad," more Cornellians would come to see the displays and would learn something of what each type of engineer does. True, this type of theme would require more displays, more explanations, and more work, but those who would do the work would gain much. It is unfortunate that "those who do the work" won't include many more students than it did this year.

—Spar

Founded in 1885

THE CORNELL engineer

MAY 1961 VOLUME 26 No. 8

COVER, designed by Leonidas Ioannou, CE '63, represents ancient Egyptians bearing a burial boat. For story on saving Nubian monuments, see page 9.

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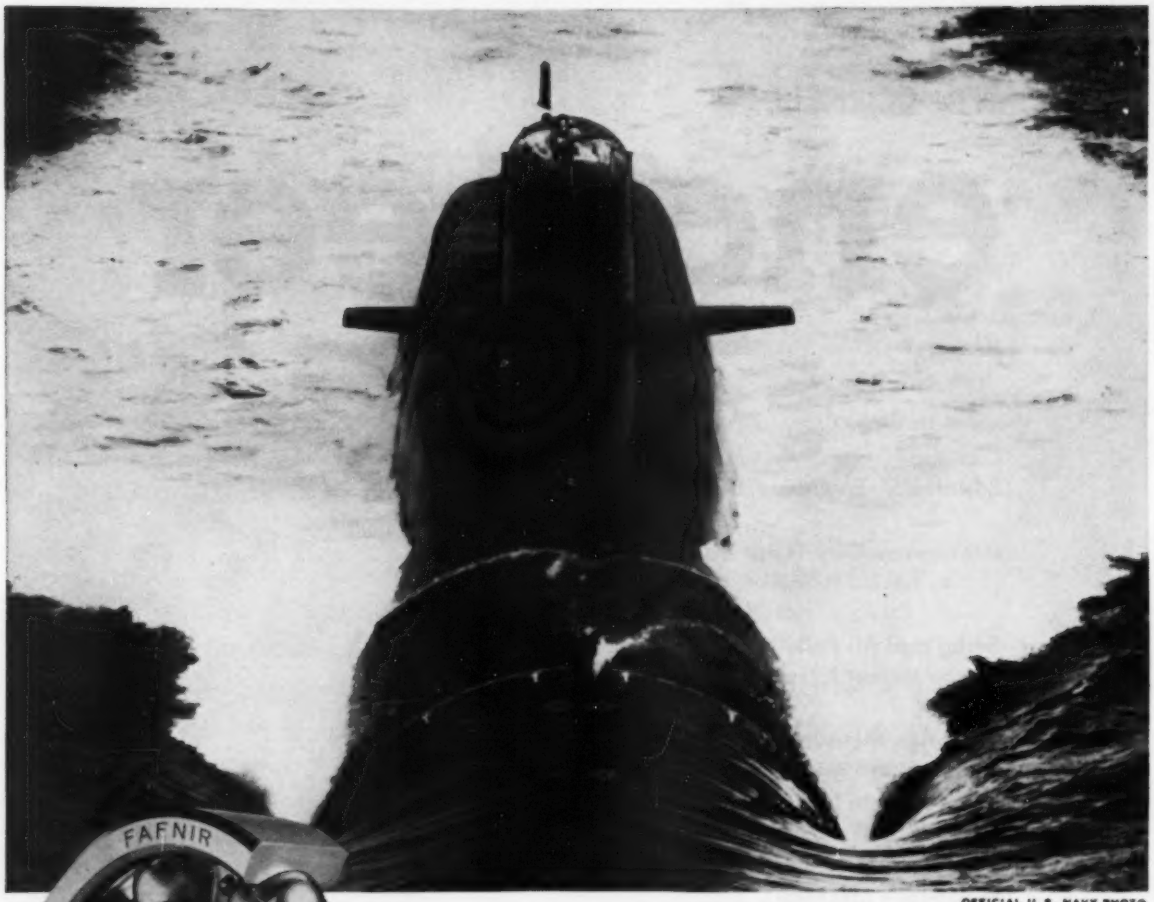

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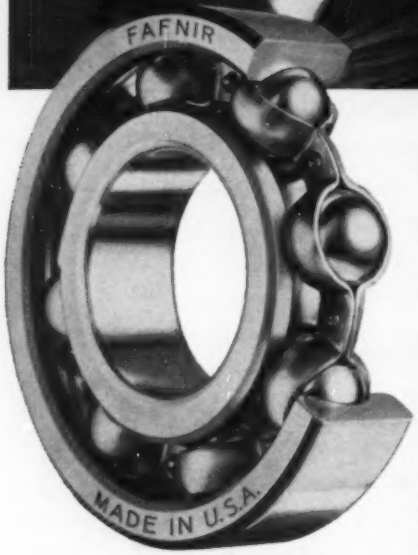

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PHOTOGRAMMETRY HELPS SAVE THE TREASURES OF NUBIA

by Edward M. Mikhail, Grad '61

Photogrammetry is generally defined as the science of measurements with the aid of photographs in order to determine such geometrical properties as form, size, and position of features in the photographs. This science started mainly with the idea of obtaining topographic maps, but it now embraces an extensive field from astronomy to microscopy. However it is believed that there is still insufficient recognition of the great possibilities of photogrammetry for purposes other than topographic mapping; such uses are sometimes referred to as non-topographic, or special, photogrammetry.

One of the fields in which photogrammetry can play a big role is archaeology. We really cannot prevent the present tendencies of general destruction of old structures to be replaced by modern ones, but we can certainly give later generations important information about our own and preceding ages. At the present time, there is a very interesting problem of how best to document and record a tremendous amount of carvings and monuments which are proposed to be soon covered by the rising water of a reservoir. It is the purpose of this article to show that photogrammetry is the most efficient method that could be used to preserve the incredibly valuable records for posterity. The above-mentioned monuments are those of Nubia in South Egypt which will be covered by water due to the erection of the Aswan High Dam.

Aerial Photogrammetry

Preceding any big project, a detailed survey of the site should be obtained. The type of survey is dependent on the kind and size of the project. The construction of the High Aswan Dam will bring into existence an artificial lake with a surface area of 1,150 square miles, which will submerge important and beautiful monuments, temples, tombs, carvings, and paintings for a distance of 300 miles along the Nile Valley. A great proportion of these monuments are either partially explored or not explored at all. All this vast area, full of magnificent treasures, needs to be partially explored and fully recorded and documented. Rapid action and quick work should be done. If we think first of a ground survey in order to get a clear picture of what would be done, we will find that this is a rather slow and time-consuming job. Therefore an aerial survey is the only practical way to get a good map of the entire threatened zone.

Planning of Aerial Photography

The area to be photographed, including the artificial lake is rather narrow. Since at this latitude the sun's altitude is high, there will be no glare trouble in flying the photography along the river.

Each photograph can be taken to cover a net length of 6000 feet, so 268 photos will be needed per strip if its length is 300 miles. The river follows a rather meandering course and therefore the flight lines will follow the course of the river. In general two strips covering a width of four miles will be enough, unless the river widens its course in which case one more strip will be needed.

Using a first-order stereoplotter, we can readily get a fine topographic map with good accuracy. It is also possible to perform aerotriangulation, thereby reducing necessary survey control. Some of the photography might have been already obtained in preparation for the design of the Dam. In this case photography for other needed areas could be obtained.

Colossi on facade of Great Temple at Abu Simbel. Width of each face is 14 feet.

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Archaeological Photo Interpretation

Aerial photography is an aid of great worth in archaeological research. Having photographs taken to a large scale helps archaeologists to plan the work of excavation and enables them to make an intelligent appraisal of the project before setting foot on the ground. In order to determine the areas which need to be photographed to a larger scale of 1:5000 to get a map to scale of 1″ = 100′, the previously obtained map and photographs are used. Once these areas are fixed the flight planning follows the same way as in the previous section. For economical reasons, it is essential, of course, to use the same camera and the same kind of formats. The pho-

ABOUT THE AUTHOR

Edward Mahrous Mikhail was born in Fayoum, Egypt, on September 11, 1935. He quickly developed an interest in mathematics while he was in primary school, and, like many an American boy, equated a liking for math with a liking for engineering. He entered the School of Engineering at Cairo University in 1952 and received his B.S. in Civil Engineering in June 1957, graduating with honors. From 1957 until December 1959 he was associated with the staff of Cairo University, after which he came to Cornell for further study through the aid of scholarships from the U.A.R. and the International Cooperation Administration.

tographs thus obtained will also be used to get precise archaeological maps of all the areas of interest. It is also through the examination of these photographs that all unexplored areas will be thoroughly looked at, and all possible monuments, tombs, cemeteries, and other burial grounds will be fixed; after which the ground survey can get under way.

What is the Solution?

Before fixing the solution to a problem like this, it is necessary to find out what precisely are the finds. There are more than 150 sites in both Egyptian and Sudanese Nubia. The sites contain ancient towns, Pharaonic temples, Christian churches, rock graves, rock chapels, complete islands of monuments, colossal statues, numerous cemeteries, carvings in rock, colorful frescoes, and tremendous amounts of hieroglyphic inscriptions. It is obvious that there will not be only one solution. The different solutions to save all these finds could be summarized as follows:

1. For isolated islands: it is reasonable to build a dike surrounding the island.
2. The carvings hewn in cliff faces as well as separate monuments could be dismantled and moved elsewhere.
3. Inscriptions and hieroglyphic writings should be recorded and precise casts made.

The function of photogrammetry is not only to get a topographic map or photos for interpretation, but it also goes far beyond this limit. It is essentially needed in every step of the different solutions mentioned above. Maps of scale 1" = 100' which are done by photogrammetic methods are required for the land planning process, together with complete record of all the details.

Color Photography

Up to this point what has been written did not specify what kind of photography should be made. Of course black and white photography is almost exclusively used in photogrammetry because the possibilities of color photography have not yet been fully explored. But, experiments made so far show that color film in all probability will prove to be valuable on a project like this one. The greatest significance of the color film is that the interpretation of photographed details is made considerably easier in comparison with ordinary black and white negative material. Nevertheless the comparatively high cost of the color film and also the rather complicated photographic procedures are still objectionable for general utilization. Therefore, photographs will be in color only for sites and objects where it proves to be essential. Besides the carvings and inscriptions in natural sandstone rocks, there are beautiful paintings and magnificent frescos which, although painted some 4000 years ago, still preserve their splendid colors as if the artist had just completed them. These masterpieces are really the objects which deserve to be photographed in color. In order to know the changes —which might be slight—that natural colors undergo, a color scale is suggested to be added to the subject and photographed with it. After development, this scale could be compared before and after photography and differences in tone for every color could be determined. Hence, any reproduction desired could be made as close as possible to the original.

Terrestrial Photogrammetry

Although most of the attention is presently given to aerial photogrammetry, terrestrial photogram-

The Great Temple at Abu Simbel. Each colossus is 67 feet high, and the grottoes extend 210 feet into the cliff.

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Greco-Roman temple built in the time of Augustus on a more ancient edifice.

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This temple was dedicated to the gods Amon-Ra and Ra Horakhtie, and was built by Ramses II about 1250 B.C.

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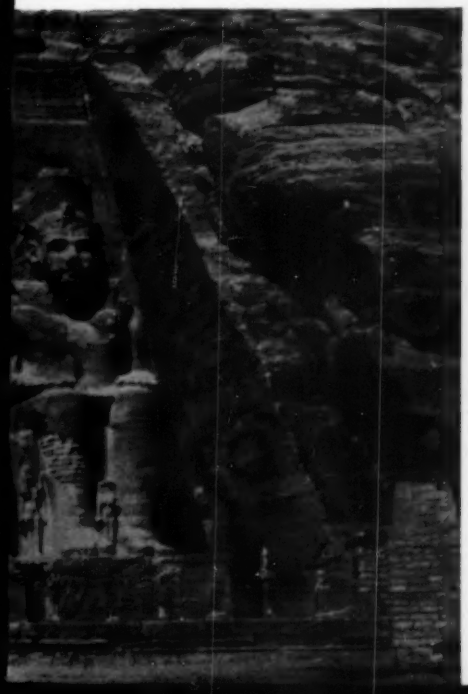
metry still proves to be a powerful tool in many respects; especially in so-called non-topographic photogrammetry. In fact, it is most valuable in this problem.

One of the most important temples of all the finds thus far is at Abu Simbul. The Great Temple—that is its name—is 108 feet high, 124 feet wide, carved out of a solid rock, and goes over 200 feet into the mountain. On both sides of the temple stand statues as high as the temple itself. No wonder that the only method which could be used to give accurate and quick results in recording and documenting all the details is photogrammetry—especially terrestrial photogrammetry.

The temple mentioned above with its huge dimensions—to be covered properly by photographs—needs a thorough design for the selection of camera stations. Due to the rather narrow coverage of the camera lens of a phototheodolite, it will not be possible to get the entire height of 108′ in one photograph. Therefore, a good, practical, quick solution is the following:



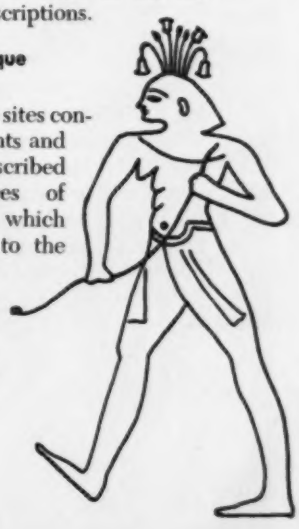
The best position for the camera will be at the centerline of temple. The phototheodolite is set at any point on the longitudinal centerline, and, with the camera axis horizontal and perpendicular to the side, the first photograph is taken. Then the alidade, with the camera, is turned through 180° to get the axis perpendicular to the opposite wall and another picture is snapped. Because either one of the photos will not cover the total height of the wall, either the camera needs to be moved upward with its axis horizontal or kept in its position and its axis turned upward so that it can cover higher parts of the wall. The former solution is recommended because of the limitations of the tilt angles of the camera. The problem now—if it is considered a problem—is that of looking for an easy way to get the camera at elevated positions on the different stations along the centerline of the temple. A simple and rapid method is to use a so-called Bilby tower which is used by the U.S. Coast and Geodetic Survey for observation at triangulation stations. It is built of steel and contains two tripods, one inside the other, so that when the observer (photographer) moves on the platform supported on the outer tripod he will not disturb the instrument mounted on the inner one. The surface area exposed to wind is very small and therefore the tower is quite steady. Of course, wind is not a factor inside the temple here considered, but it might be at other sites. This tower can be erected or taken down in a surprisingly short time, and it also could be used over and over again. It could be elevated to suitable heights. To facilitate the work and minimize the time factor it is suggested that the tower could be fixed with rollers which move on a temporary track along the centerline of the temple. For relatively low heights the camera could be mounted on a motorized lift truck which is used as a substitute for the Bilby tower.

Illumination of the interior of the temple during photographing could present some trouble. This could be overcome by the use of flood lights on stands and connected to a movable generator set which will serve as a power station. These stands should be properly placed to give the best shades and sharpest features, and then moved from one place to another where needed for the next photograph.

In this project the amount of relief in the photographed objects differs considerably. It ranges from a desirable contour interval of 4 inches in colossal statues (like the one whose mouth is 42 inches wide) to a maximum of half an inch in the hieroglyphic inscriptions.

Tilted or Oblique Photography

Some of the sites contain monuments and carvings inscribed on the faces of rocky cliffs which are so close to the river that there is no room for the phototheodolite to be



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Facade of Temple of Isis at Philae.

set. In this case a plane flying at a relatively low altitude can take oblique photography for these façades. In some other cases inscriptions and paintings are found on the ceilings as well as on the walls. For photographing these, a bracket with a plate for attachment of the phototheodolite could be designed and mounted with its axis making large angles with the horizontal or else vertical.

The use of photogrammetry does not stop at the point of recording and documenting the "finds" in the form of files of photographs. For example, after the contour lines are drawn for a frieze, the map is placed in a pantograver which will follow every detail of the stereoscopic plotting, reconstructing the frieze on scale required. It is very possible to develop a gadget which can be coupled with the pencil in the stereoplotter and instead of getting a contour map (if not required) a plastic model is obtained directly from the stereoscopic model. There is another case in which photogrammetry can offer a rapid solution. The weights of the monuments which will be dismantled and moved to other places need to be known to a reasonable accuracy, because on these weights depends the choice of cranes and equipment which will be used in the job. Instead of determining the volume from an intermediate contour map, it could be obtained directly by coupling a suitably adjusted planimeter to the drawing pencil. In many cases the monuments are so enormous that they need to be cut into pieces. The size of these pieces which will suit the capacity of the equipment used could be determined by adding a grid drawn on a glass plate which in turn is coupled to the diapositive. During the determination of the volume, the operator can follow the line on the grid which will suitably satisfy the technical archaeological requirements and the volume (and consequently the weight) limitations.

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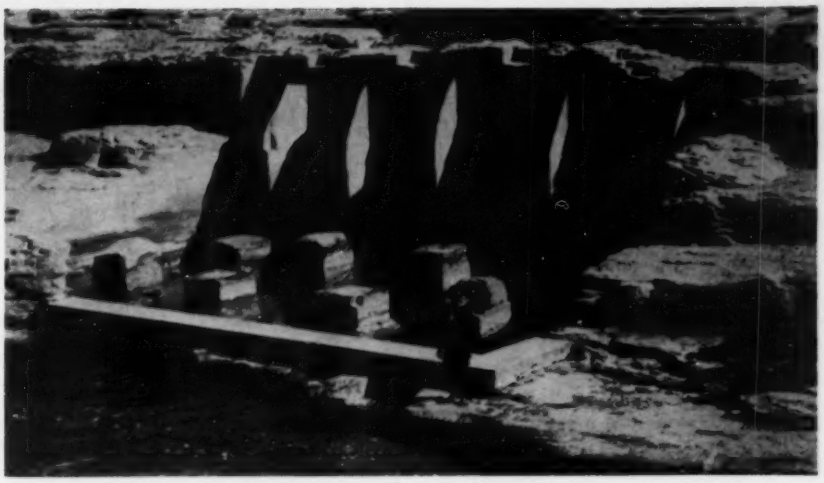
Photogrammetry opens up new horizons in the knowledge of forms and techniques. It may even make possible the discovery of architectural laws as yet undiscovered by Egyptologists and may add to archaeologists' knowledge of sculptural techniques. For instance, the contour lines taken on the face of the North-West Osirian Colossus (23 feet) in the inner court of the great temple of Abu Simbel, and those taken on the face of the South Colossus (65 feet) on the facade, show some striking resemblances between the two, even down to the modeling of the cartilage of the nose.



Temple, about 125 miles south of Aswan, was built about 1250 B.C. Only four of the original 12 pillars remain standing.

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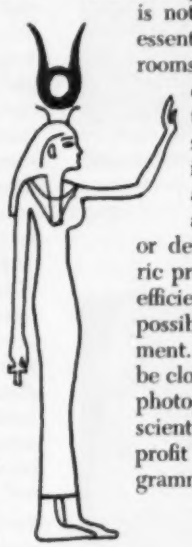
Conclusion

It is apparent that nearly everything around us is in a transitory state of destruction and that there may come a time when the rate of destruction will be very rapid. Photogrammetry represents then a most powerful tool, not to prevent destruction, but to make possible an accurate, nearly ageless reconstruction. So, under present circumstances we should set out to establish as quickly as possible archives containing photogrammetric data of at least the most important cultural monuments.

An advantage of the photogrammetric process is that it need not immediately be carried to completion in measured drawings, but that photographic plates, with a small amount of required survey control data, can be stored, and may be set in the plotter and the three-dimensional model established years later when needed. It is also apparent that this science is not required for recording essentially bare rectangular rooms, but that with every increase in complexity of the architecture, in subtle color illusion, in irregularity of material and surface, and in inaccessibility of structure or detail, the photogrammetric process becomes the more efficient and finally the only possible system of measurement. Therefore, there must be closer cooperation between photogrammetrists and other scientists who will certainly profit by the use of photogrammetry.



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Details of various monuments show, left to right, Temple at Philae, a bas-relief from a Temple at Philae, three colossi in entrance hall of Great Temple at Aba Simbel.

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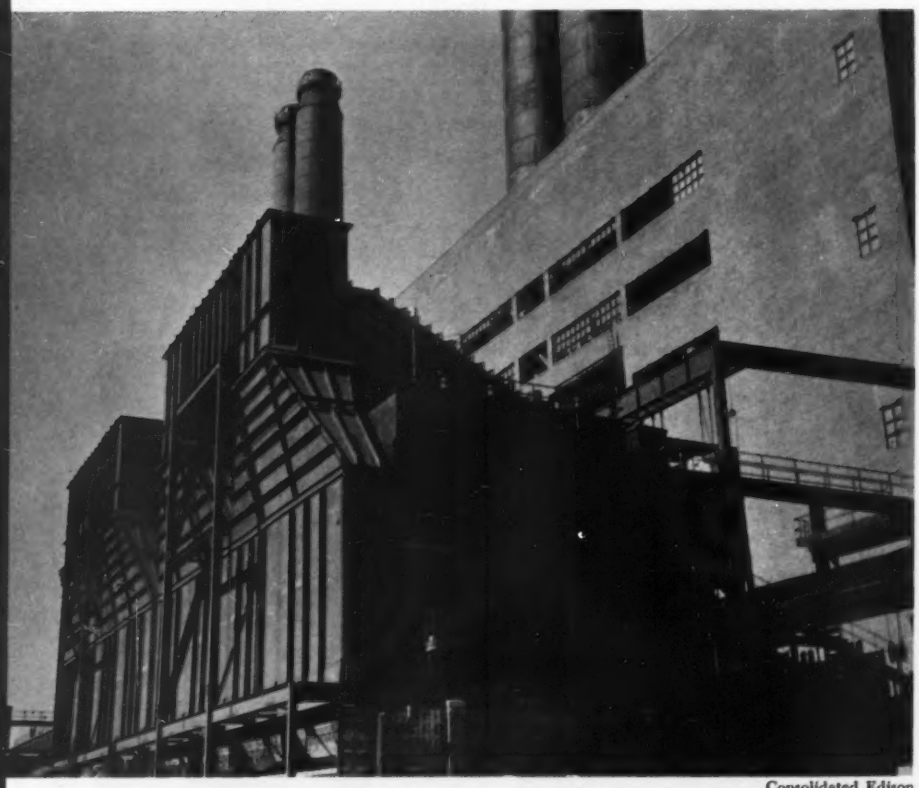
SMOG AND AIR POLLUTION

by Michael B. Goldstein, EE '65

Air pollution is not a new problem. Ever since man learned to create fire, he has been filling the atmosphere with smoke, cinders, and ash; today these same materials cause our greatest air pollution problems. Almost 700 years ago, the Queen of England moved from London to Nottingham because of severe smoke. Queen Elizabeth, three hundred years later, sorely afflicted by the coal smoke pouring out of the Westminster breweries, prohibited the burning of coal in the city while Parliament was in session. However, it is only in the last few years that the real danger of air pollution has been realized, and effective steps are finally being taken against it.

Air pollution itself is a very complex phenomenon. Certain mixtures of gases are much more irritating and dangerous than others. In some areas, one type of air pollutant may be very common, while in other places it may be nonexistent. Practically the entire air pollution problem in Los Angeles is caused by the emission of unburned hydrocarbons from automobile engines, yet in London, where the major pollutants are coal smoke and ash, automobile fumes play a minor role. Obviously, the same methods cannot be used in both cities to maintain clean air. There is no single, simple solution to the problem of air contamination. Indeed, each area presents a unique and challenging problem.



Consolidated Edison

This is part of the smoke precipitating equipment for a large power plant boiler, costing approximately 5 million dollars.

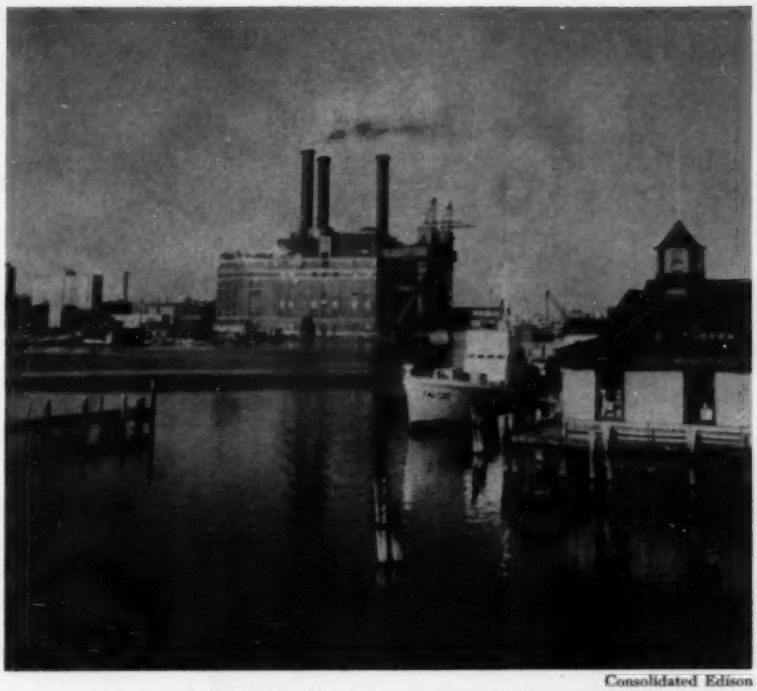
The city most famous for "smog" is Los Angeles. Three major factors have made that city exceptionally prone to severe air pollution problems. The first is the huge number of automobiles that operate in Los Angeles county. Many tons of unburned hydrocarbons are fed into the atmosphere daily from these vehicles. This condition is aggravated by the intense sunlight which converts these products into such annoying gases as ozone. In fact, the ozone concentration in Los Angeles is higher than anywhere else on earth. The final factor is the meteorological conditions that exist over the city. Los Angeles is situated in a valley, surounded on three sides by mountains. Frequently, a layer of cool air is trapped by the mountains and pressed down by a blanket of wam air. This "inversion layer" prevents air circulation over the city, thereby holding in all the exhaust gases and allowing them to build up to alarming concentrations. The concentration of ozone and other noxious gases has on occasion become so high that plants have withered and paint has blistered off walls. The seriousness of the situation has prompted the city govenment to establish the Air Pollution Control District and to pass numerous laws banning such things as rubbish burning and industrial smoke. Failure to comply with the smoke control ordinances can bring heavy fines and even condemnation of the offending plant. But, even with this regulation, the situation in Los Angeles has not become much better. More and more cars are entering the sprawling city, and with them comes the menace of increasing ozone concentrations. The only solution to Los Angeles' problem is to devise a system to remove the hydrocarbons from the exhaust before they get into the air. Afterburners, devices that burn the exhaust vapors, are being tested as one method of reducing the un-

burned exhaust fumes. Cracking the hydrocarbons into molecules that will not convert into ozone so easily is also being investigated. However, it will be at least a year before either of these systems becomes economically feasible.

While the Los Angeles air pollution problem is very interesting, it is by no means typical of the situation that faces most cities. The extreme inversion condition, the tremendous number of cars, the intense sunlight, and the lack of appreciable heavy industry make Los Angeles unique among American cities. The air pollution condition in New York City is considerably more typical of that found in many industrial cities throughout the world. In New York there is considerable smoke-producing industry, a great number of cars, thousands of incinerators; in short, almost everything needed for first class smog. Fortunately, the geographical location of New York precludes the formation of an inversion layer for all but a very few days each year. Thus, most of the conditions that contribute to New York's air pollution problem are of a man-made nature and are potentially controllable.

A major component of the atmospheric pollution in New York is smoke from industrial furnaces. The Consolidated Edison Company of New York supplies most of the electrical power for the city through the operation of nine large steam-electric generating stations. Con Edison is quite representative of the type of heavy industrial complex found in large cities, and its problems in the field of air pollution control are shared by companies throughout the world. During the past twenty-five years, Con Edison has spent more than $100,000,000 on smoke control programs. Three generating stations recently purchased from the city are now being modernized to eliminate excessive smoke production. The cost for these three plants alone will come to about $5,000,000.

The great bulk of smoke coming from these plants is caused by incomplete combustion of the fuel and the blowing of ash particles up the stack and into the atmosphere. Incomplete fuel combustion not only adds to air pollution, but it is also very uneconomical. Stoker-fired coal fueled boilers are the chief cause of the pollution problem. The relatively large amount of fly ash that is sent up the stack is too great even for economical removal by electrostatic precipitators. One of the generating stations that Con Edison purchased was equipped with forty-eight stoker-fired boilers. These were found to be so inefficient and smoke-producing that all but eight have been shut down pending the installation of new oil-fired high-pressure boilers. Over the past three years, when the station was operating with all forty-eight boilers, soot-fall in the vicinity of the plant averaged almost *two hundred* tons per square mile.



Consolidated Edison

The electrostatic precipitators on left stack are de-energized, demonstrating the effectiveness of control equipment.

In other cases different methods have been used to eliminate unnecessary air pollution problems. At a number of plants, the most effective way of controlling smoke and ash has been to install combinations of electrostatic and mechanical smoke filters to trap most of the waste. At one generating station, television cameras are used to watch both the smoke flow from the stacks and the water level inside the boilers. By observing these two things and taking corrective steps if a dangerous situation arises, smoke pollution can be greatly reduced. Con Edison has greatly reduced its contribution to New York's air pollution problem through these methods.

New York City has taken steps on its own to curb air pollution. An apartment owner operating a smoky incinerator may be subject to fines or, in extreme cases, imprisonment. The burning of leaves has been prohibited, and the huge Sanitation Department garbage incinerators have been equipped with smoke control devices. The Department of Air Pollution Control has been actively working not only to ferret out violators of the air pollution laws, but to educate both the public and industry in methods of preventing further increases in pollution.

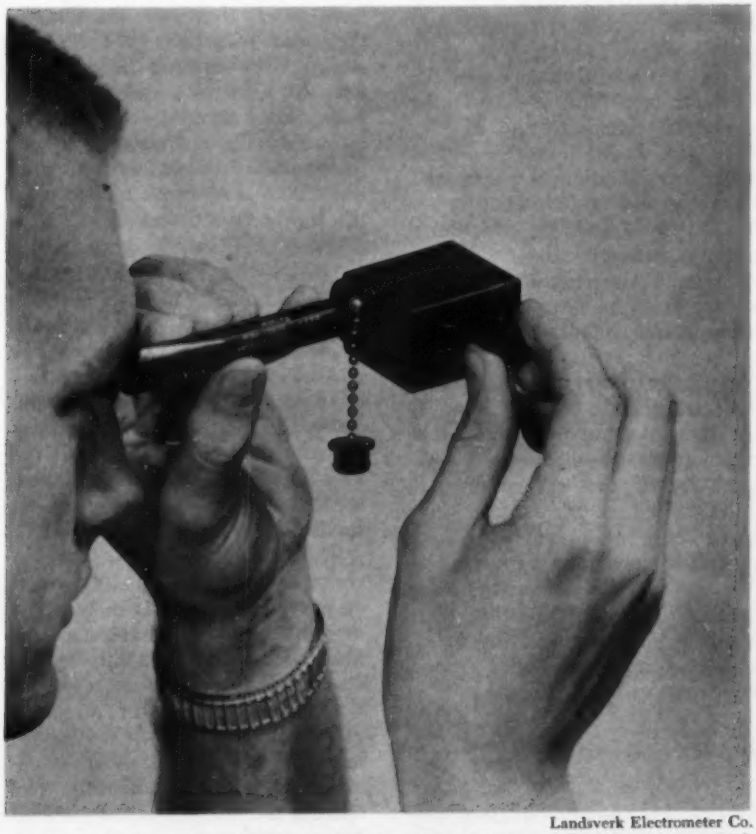
Industry alone cannot eliminate air pollution. Neither can government legislate it out. There must be a cooperative effort between all groups concerned in order to control this menace to our health and safety. What has been done so far is only a small start. Much more is needed; in research, construction, and legislation – and it must be done soon.

RADIATION MEASUREMENTS

by Joseph Braunstein, Arts '64

Ever since the discovery of Roentgen radiation, research in the field of nuclear physics has been hampered by safety problems. Many of the foremost researchers of the day became victims of radiation diseases before the hazards of overexposure were recognized.

We are all exposed to background radiation, with negligible effects. But does a "threshold" exist below which radiation has no effect upon the body, or is radiation hazard directly proportional to the dose of ionizing energy absorbed?



Landsverk Electrometer Co.

This ionization-type pocket dosimeter is being charged to a specific capacitance which is observed directly as the unit is charged.

In 1928 at the Second International Congress of Radiology in Stockholm, a standard of x-radiation, the roentgen (r), was established. (The wording of the original definition was slightly changed to its present form in order to include gamma-radiation in the definition.)

"The roentgen shall be that quantity of x- or gamma-radiation such that the associated . . . emission per 0.001293 gramme (1 cc.[3]) of air produces, in air, ions carrying one electrostatic unit . . . electricity of either sign."

With the establishment of an internationally accepted standard of radiation the basis for radiation dosimetry was also established. The arrival of two more units of measurement, the rad and relative biological effectiveness (RBE), expanded the field. The rad is defined as the unit of absorbed dose. (1 rad=100 ergs/gm of absorbed energy.) RBE is the factor of difference in effect of the same quantities of radiation of different types. This factor recognizes the greater ability of certain particles to produce damaging ionizing radiation and free radicals in the body. Hence a new biological unit may

be derived, the rem (roentgen-equivalent-man. Dose in rem = Dose in rad × RBE).

Any dosimetric system would now have to measure the ionizing power of a source of radiation in comparison with a standard roentgen air cell. Secondly, it would have to compensate for the RBE factor of different types of radiation in tissues.

Biological Effect

The net effect of radiation on an organism depends upon three factors: the nature of the radiation, the radiosensitivity of the organism, and the span of time. As mentioned above, alph-, beta- gamma- and x- radiations and neutrons have varying ability to induce ionization throughout the body. Furthermore, certain body cells are more resistant to the effects of radiation than others; e.g., nerve cells are considered radioresistant while the linings of blood-vessels are considered radiosensitive.

A large single dose of radiation has a greater effect on the body than a series of smaller doses spread out over a long period of time. Apparently enough healthy tissue remains after a small exposure to replace affected tissue. A large single dose would destroy too many cells for repair to begin.

From observed effects among technicians and scientists exposed to excess radiation, the Zurich Congress on Radiology (1934) recommended a "tolerance dose" of one r/week. In 1950 a new standard of 0.3 r/week "maximum permissible dosage" was established. This reflected the new opinion that any radiation is harmful to some extent.[1]

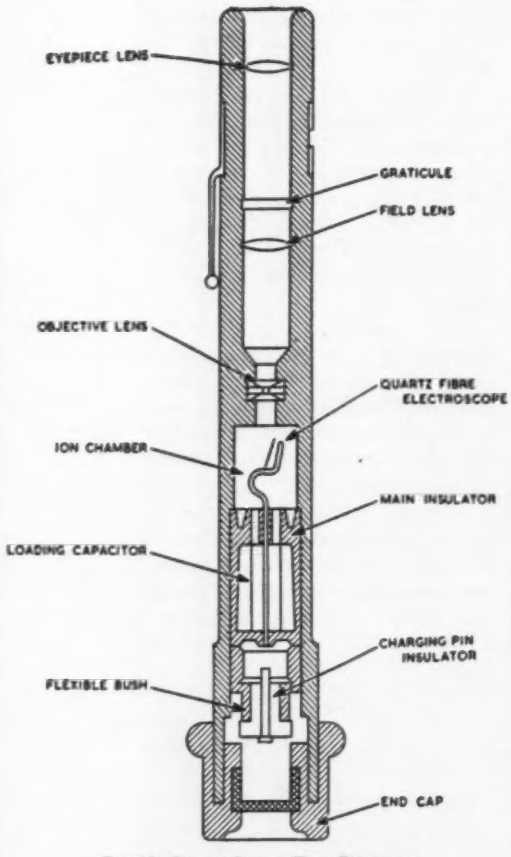


FIG. 36. POCKET QUARTZ FIBRE DOSIMETER

C. C. H. Washtell

Cross section of a condenser-type pocket dosimeter, showing the ionization chamber and optical system.

Types of Dosimeters

Just as there are many types of thermometers with which to measure heat radiation, there are many different radiation dosimeters. Each type has its own optimum range and specialized applications. Briefly, dosimeters may be divided into three major types: ion dependent, radiation transfer, and radiochemical.

Ion dependent meters are the most common type. Geiger-Müller ionization chambers and electroscopes are based upon the ability of nuclear radiation to create ions. Electrons and positive charges are created in amounts proportional to the radiation present.

Energy transfer meters absorb energy from radiation and transform it into light or heat which can be measured directly. In the case of light energy, a photomultiplier is generally used to amplify the signal to measurable amounts.

Among the chemical methods, we have the original system of radiation measurement, radiosensitive films. These are in common use for recording low range routine exposure, as at the University's Newman Laboratory. In addition, there are new methods involving oxidation of ferrous-ferric and cerous-ceric ions.

Pocket Dosimeters

Technicians, scientists, and even visitors to nuclear radiation laboratories wear some type of radiation monitoring device. On of the most convenient of these is the direct-reading pocket ionization chamber. Usually the instrument comes in two parts: an anodized aluminum ionization chamber with two insulated plates (one may be the cover of the chamber), and a charging unit with a voltmeter. By placing the ionization chamber in the well of the charger, the circuit is completed between the two plates and a battery. This charges the plates to a specific voltage and makes it a condenser-type apparatus. When radiation ionizes the gas between the plates, the ions travel toward opposite poles and discharge the plates of the condenser. Hence, the change in potential from the original impressed voltage may be calibrated directly in roentgens. These instruments, as seen in Figures 1 and 2, are usually accurate to plus or minus ten percent for gamma radiation. There is some inaccuracy due to leakage of charge, background radiation, and the fact that not all of the gamma radiation is absorbed.[2]

Neutrons present another problem. Since they are uncharged, they may pass through the small air chamber causing little or no ionization. In some cases neutrons may simply dissipate their energy by unreactive collisions with gas molecules. However, neutrons will react with an isotope of boron in the capture reaction:

$${}_5B^{10} + {}_0n^1 = {}_3Li^7 + {}_2He^4 + \text{energy}.$$

The energized alpha particle and lithium nucleus can then produce ions. Therefore, if an ionization chamber is lined with boron or filled with boron trifluoride gas, a quantitative measurement of the neutron radiation can be integrated with the gamma-ray measurement. Ion chamber dosimeters may be made for doses as small as .2 r or greater than 600 r.

There is another type of ion chamber dosimeter which is a variation on the usual meter. Although it is less accurate, it is sufficient for its low intensity range (0-1r) and very convenient to operate. It consists of a sealed aluminum ionization chamber at one end of which is a scale enclosing two iron spheres. The spheres are charged electrostatically by rubbing the chamber vigorously on a flat surface. The charged

spheres repel each other a given distance on the scale representing 1000 mr of radiation. A magnet on the barrel of the instrument locks the spheres into place, and prevents them from charging up any further. As radiation produces ions in the chamber, the spheres discharge and gravitate toward each other. The distance between the spheres is an approximate measure of the quantity of radiation.

Energy Transfer

Storage phosphor dosimeters may be used to measure integrated x- and gamma-radiation doses of over 10 r. According to theories of radioluminescence, nuclear radiation excites electrons in crystals to a metastable state. Subsequent irradiation with certain wavelengths of light raises the "trapped" electrons to higher energy levels from which they can drop back to the ground state, releasing different wavelengths of light. These resulting light rays are usually detected by a photoelectric cathode in conjunction with a photomultiplier tube. The amplified current is then directly proportional to the light emitted, which in turn is a measure of previous x- or gamma-radiation.

A prominent and still promising member of the dosimetry family is the film badge. Just as you can take a normal "light picture" of your surroundings, you can take a radiation picture.

Photographic film is made which is sensitive to nuclear radiation of varying energy ranges.[3] Using a combination of films of different ranges, a badge may be made sensitive to a broader range of energies than many other instruments. (0 to 10,000 r.) Used along with the proper filters, a film badge may determine the integrated x- and gamma-ray exposure as well as beta and thermal neutron doses. A special "loaded" film (incorporating boron, hydrogen and lithium to react with neutrons) may be used to measure thermal neutrons.

Film badge dosimetry isn't as simple as presented here. There are difficulties in developing and analyzing data from irradiated films, in addition to problems of fading and emulsion changes due to heat and drying. Also, there is the inherent inconvenience of delay in developing.

Chemical Dosimetry

Through radiochemistry many reactions have been found which are induced by x-ray or gamma ray exposure. The problem is to find some chemical change whose yield is proportional to the amount of radiation, and which isn't affected by change of temperature or other conditions. Experiments have been conducted, with fair amounts of success on chlorinated hydrocarbons with certain yield stabilizers. Other dosimetry systems like ferrous-ferric and ceric-cerous reduction have been found inaccurate because of spontaneous oxidation and reduction of these ions. In general, chemical dosimetry systems are in a range above other meter types.

A working knowledge of radiometry will be essential in the field of space travel. Also, scientists exploring the insides of atoms need safety devices to protect them from overexposure. In the next decade the field of radiation measurement will play an important part in the safety of all people in our nuclear age.

ACKNOWLEDGEMENTS

Cambridge Instrument Company Inc.; New York, New York.

The Landsverk Electrometer Company; Glendale, California

Rinn X-ray Products Inc.; Chicago, Illinois.

Specialty Electronics Development Corporation; Syosset, New York.

Mr. Richard Schectman, Cornell Physics Department.

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FOOTNOTES

1. Barnes, *Radiation Hazards* p. 34.
2. C nbridge Electrometer Corporation.
3. Hine, et al *Radiation Dosimetry* p. 483.
4. *Ibid*, pp. 489–90.

Retiring Staff

Three members of this year's *Engineer* staff retired as the new staff assumed office in April. In appreciation for their services to the magazine, we would like to introduce them to our readers, who have seen the results of the staff's work throughout the year.

Retiring Editor-in-Chief **Bob Franson** has filled his critical pen with the traditional black ink and awaits next year's issues in his new position as Student Advisor. Bob joined the *Engineer* as a freshman Illustrations Board member, and later directed the training of Illustrations compets. During his junior year, while Bob was Illustrations Editor, he and his staff produced several imaginative covers, one of them an Engineering College Magazines Associated prize-winner. Since his election to the editorship, Bob has attempted to re-focus the *Engineer's* content on Cornell—and has succeeded admirably.

Bob's leadership and diversity of interests are reflected in his other activities on the Hill. He recently became president of Acacia Fraternity, and previously served the house by helping to revise its rushing booklet and by acting as Scholarship Chairman. The house presidency, he declares, will provide him with quite an active "retirement." As a member of Engineering Council, Bob helped to pioneer the new freshman tutoring program. He is also a member of Pi Delta Epsilon journalism honorary. On the home front (Rowayton, Connecticut), Bob enjoys sailing his Lightening-class sloop, *Cheetah*.

In his four years of engineering physics, Bob has explored a wide range of topics, including philosophy, German, and linguistics. Next year, in addition to completing a fifth-year project, he expects to study quantum mechanics, solid-state physics, and more linguistics. For the future, Bob is considering the fields of college teaching and technical publishing.

Service with a smile—the Armed Services, that is—spotlights **Larry Rosenthal,** our retiring Business Manager. A graduating EE from Brooklyn, New York, Larry expects to utilize his advanced ROTC training in the non-flight engineering division of the Air Force. Immediately after graduation, however, he plans to enter law school. Larry has held a Regents Scholarship while at Cornell.

Larry joined our staff in his sophomore year, and rose to the position of Advertising Manager as a junior. While Senior Editor during his fourth year, he undertook a detailed survey of the *Engineer's* campus readership. Larry's services to the magazine have brought him Pi Delta Epsilon membership.

Among Larry's other activities on campus are Arnold Air Society, AIEE-IRE Student Chapter, and Delta Club. He also plays squash, but sadly cites a rather high casualty list among his partners as a reason for present inactivity in the sport. "Furthermore, I've allowed academics to interfere recently," he quips. In spare moments, Larry enjoys reading "anything I can get my hands on," especially historical and science fiction.

Deanna Palmer became a staff secretarial assistant as a sophomore, and has served as Office Manager during the past staff year. Now a senior biology major in the Ag School, she has held a Cosmopolitan Lodge scholarship.

Pursuing her interest in biology, Deanna has worked as an assistant in the genetics laboratory. During the past five summers, she has assisted in the laboratories of Yale in her home town of New Haven, Connecticut. There she helped conduct research studies on enzymes and the neurospora, a mold.

A quick gaze into the crystal ball, however, does not reveal Deanna behind the microscope. After her graduation this June, she hopes to teach, or attend graduate school to obtain a degree in education. Fortified by a warm interest in people and their problems, Deanna would like to enter the guidance field.

Deanna's other campus activities underscore this interest. During her junior year, she served as a freshman dormitory vice-president. Deanna has been social chairman of Phi Sigma Sigma sorority and a Panhellenic Workshop chairman. During leisure hours, she enjoys listening to classical records or playing a friendly game of bridge.

As the new staff assumes office, with new names on our masthead and red pencils brandished in new hands, the *Engineer* pauses to say a big "Thanks" to these three who have been so largely responsible for this year's success.

Unesco et al

COLOSSI OF A BYGONE ERA Left to Right: Deanna Palmer, Ramathan Toole, Larry Rosenthal, Bob Franson.

FACTS ABOUT
AIR FORCE
OFFICER TRAINING
FOR ENGINEERS

Who is eligible?

College graduates, with a degree from an accredited college or university, who are U.S. citizens 20½ to 27½ at time of application. Male applicants may be married or unmarried; female applicants must be single and have no dependents. Applicants must complete written and physical examinations for commissioning.

What kinds of engineers are needed most?

Aeronautical, electrical, mechanical, civil, architectural, industrial. (Also graduates with any degree who majored in nuclear physics, engineering physics or meteorology.)

What is Air Force Officer Training School?

A precommission training course of 3 months' duration at Lackland Air Force Base, Texas. Officer trainees upon graduation receive a commission as second lieutenant. They are then assigned directly to duty or additional training.

Does the Air Force offer career opportunities?

Yes. Technically trained officers have a particularly bright career outlook. They have good opportunities for graduate study.

How can further information be obtained?

Write to OTS Information, Box 7608, Washington 4, D.C., or inquire at any Air Force Recruiting Office, listed in the telephone directory under "U.S. Government—Air Force."

Civilian Career Opportunities

The Air Force also offers challenging jobs for engineers as civilians. Write to Directorate of Civilian Personnel, Hq. Air Force Systems Command, Andrews Air Force Base, Washington 25, D. C., concerning opportunities for individuals with degrees in aeronautical, electrical, electronic, and mechanical engineering. Write to Directorate of Civilian Personnel, Hq. Air Force Logistics Command, Wright-Patterson Air Force Base, Ohio, concerning opportunities for individuals with degrees in industrial engineering.

THIS YOUNG ENGINEER IS ON THE ROAD TO MANAGEMENT

Dick Cotton knew he wanted to take the engineering route into management long before he joined New Jersey Bell Telephone Company. In fact it was his goal when he was working for his engineering degree at Rutgers.

When he graduated, he had his lines out to eleven other companies. He came to New Jersey Bell because: "I didn't feel I was just a number to these people. There was no doubt in my mind that this job would be the best for the long pull."

His first assignment was a tough one. A complex of major telephone cables lay in the path of the approach to the new traffic level of the George Washington Bridge on the Hudson. Dick's job was to find the most practical and economical way to reroute these cables, and at the same time to provide for future telephone growth in the area around the bridge approach.

Dick ironed that one out and got a crack at another tough job.

Next stop: New Jersey Bell Headquarters Engineering Staff, Special Studies Group. Here Dick was a member of a four-man team whose job was to find ways to eliminate some of the routine work of field engineers to give them "more time to think." Dick also helped plan and control a $100,000,000 annual telephone construction budget.

Presently, Dick is responsible for telephone equipment engineering projects in the Camden, New Jersey, area.

How does Dick look at it? "This is a growing business. I work with this growth every day. And growth means more room at the top. Of course, I don't figure I'll get there overnight—but on my jobs so far I've had a chance to take a good look at how this business is run. And I think the sky's the limit for a man who really wants to work for it."

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FREDERICK R. KAPPEL, *President*
American Telephone & Telegraph Co.

BELL TELEPHONE COMPANIES

CORNELL SOCIETY OF ENGINEERS

Paul O. Gunsalus

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish closer relationships between the College and its alumni."

THE PRESIDENT'S LETTER—

The two Society meetings scheduled for April went off as planned. John Gnaedinger reports that the joint meeting with the Cornell Club of Chicago took place on April 20 at the Lake Shore Club. The speakers were Professor Blanchard Rideout, Director of the Division of Unclassified Students, and Coach Tom Harp. It was very well attended, with a total of 110 present, including a total of 20 fathers and their high school sons who are sub-frosh or otherwise interested in Cornell. Don Haude went out to attend this meeting and reported that the program was excellent. John also reports that they have scheduled another meeting of the Chicago Chapter on Tuesday, May 16 at the Chicago Engineers' Club.

Walter Hickey of the Boston Chapter reports that they had a joint meeting with the Cornell Club of New England on April 25 at the Faculty Club, with an attendance of about 60 people. The speaker was Professor Steven Muller, Professor of Government at Cornell University. Also at this annual meeting, the following officers were elected:

President	– Edward F. Arps – '55 M.E.
Vice President	– Malcolm C. Hecht – '47 Chem. E.
Secretary	– Robert P. Ackert – '55 C.E.
Treasurer	– Richard J. Gilbert – '49 C.E.

Walter advises me that they are having an organization meeting on May 16 to plan the program for the coming year.

With respect to the Annual Meeting of the Society held in New York on May 4, this was one of the standout meetings of the year. We had invited 200 prospective freshmen who had been accepted by the College of Engineering as our guests and over 100 attended. Dean Corson did a very fine job in explaining the new approach to the Engineering College curricula, whereby all engineering students take common courses during the first two years. The boys responded with many questions, showing the value of such opportunities for prospective freshmen to get acquainted with the Dean.

Three items of business were accomplished. The new Constitution which was printed in the March issue of the Cornell Engineer was adopted unanimously. The present officers were re-elected for another year. And finally, it was the occasion of the formal notification to Dean Corson of the Society's gift of $750 to be used toward a faculty education project. As stated in the Constitution the purpose of the Society is "to promote the welfare of the College of Engineering of Cornell University and to foster a closer relationship than would otherwise be the case between the College and its alumni, for the benefit of that institution." I know of no more tangible evidence of fulfilling that objective than the support we can give to the Dean for projects which will advance the effectiveness of the teaching staff. This gift equates to 25¢ for each of the 3000 dues-paying members; individually, an insignificant sum, but collectively large enough to accomplish a very worthwhile result. How much more could be done if all 20,000 Engineering College Alumni supported the Society! How about inducing some of your engineering friends to join up next year?

Best wishes for a pleasant Summer.

PAUL O. GUNSALUS

ALUMNI ENGINEERS

Edited by
Robert Sanderson ME '65

Frank D. Newbury, ME–EE, '01, was editor-in-chief of the Sibley Journal, a predecessor of the present Cornell Engineer. He went to work for Westinghouse in 1901, and worked his way up to the top by way of design, power, and machinery engineer to Vice-President in 1947, when he retired. From

Alumni News
Frank D. Newbury

1945 to 1958 he was US Assistant Secretary of Defense for engineering. His offspring have also brought credit to the family; Mr. Newbury's son is an engineer with Bendix Corp., and his daughter is an associate professor of psychiatry at the University of Pittsburgh. Since his retirement, he and his wife have spent winters in Florida, and summers at Chautauqua. At present the Newburys live in Washington, D.C.

Berlyn Werly, MEE, '22, is presently assistant manager of engineering, construction, maintenance and utilities organization at the Kodak Park Works of Eastman Kodak in Rochester, and will become manager on June 1. He joined Eastman Kodak in 1922 as an electrical engineer, and in 1930, assumed charge of the plant engineering, power generation and distribution. He has worked at the Clinton Engineering Works in Oak Ridge, Tenn., and assumed his present position in 1954. He is a member of the AIEE, NYS Professional Engineers, and the Rochester Engineering Society. He and his wife live just outside of Rochester in a town called Irondequoit.

Edwin L. Harder, EE '26, is director of the advanced system engineering and analytical department of Westinghouse Electric Corp., in Pittsburgh. He has been elected technical vice-president, representing the science and electronics division on the AIEE board of directors. Mr. Harder will be at Cornell in June for the meeting of the AIEE. He has four sons, one of whom he hopes, will enter Cornell this fall.

Floyd W. Hough, CE '19, has been elected president of the section of geodesy of the American Geophysical Union for a three year period starting July 1. He is currently completing a term as vice-president. A consulting engineer in geodetics, Mr. Hough is president of Geonautics, Inc. He has served in the army as lieutenant colonel, and was with the US Coast and Geodetic Survey in earlier years.

Kerr Atkinson, ME '12, who is a consulting engineer in Boston, has been elected a fellow of the American Society of Mechanical Engineers. Kerr specializes in industrial and public power generation, distribution and application. Before he went into private practice in 1951, he had been employed by the electrical department of the Lehigh Coal Co. until 1917, when he entered the Army; recently he worked for twenty-six years as a project engineer for Jackson & Moreland, in Boston.

Ted Heine, EE '29, is supervising engineer for the New York Telephone Company. He is a frequent visitor to the Campus, and attends the NY Telephone Company's advanced communications course here at Cornell. Mr. Heine has a son who is teaching at the Air Force Academy.

Robert E. McGayhey, BS–EE, '48, who has been with IBM since his graduation, has recently been promoted to development engineer in the mechanical device development section of the IBM Poughkeepsie Product Development Laboratory. Mr. McGayhey, his wife and three children live in Poughkeepsie, New York.

John G. Aldworth, BSAE '42, has been promoted to manager of Westinghouse's electric utility sales department. Mr. Aldworth was formerly sales manager of the power control and communications department at the East Pittsburgh plant.

Mr. Aldworth joined Westinghouse in 1946 as an electric utility salesman in New York. In 1956 he became sales manager of the carrier-microwave department at Baltimore and in 1959 sales manager of the power control and communications department at East Pittsburgh.

At a recent meeting in Ithaca, members of the Cornell Society of Engineers met with officials of the College. Left to right: Stephen D. Teeter, John J. Hillsley, Ladimir R. Zeman, Donald D. Haude, William M. Leonard, Dale R. Corson, Paul O. Gunsalus, Roscoe H. Fuller, S. C. Hollister, F. Crampton Frost, Walter L. Hardy, George F. Mueden, N. A. Christensen, William F. Gratz, M. D. Morris, J. F. McManus, Gordon P. Fisher.

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COLLEGE NEWS

Edited by Joel Lichtenstein EE '64

HAMILTON AWARD PRESENTATION

The 1961 Hamilton Watch Award has been awarded to Lloyd David Malstrom, EP '61. The award, an engraved electric watch, has been given annually since 1951 by the Hamilton Watch Company of Lancaster, Pennsylvania to encourage greater understanding of the social sciences and humanities among engineering students. It is presented to the fifth year student who "has most successfully combined proficiency in his major field of study with noble achievements in the social sciences and humanities."

Lloyd came to Cornell from Jamestown, New York, with a National Merit Scholarship and a New York State Regents Scholarship. He has been a member of the Cornell Debate Association since his freshman year and is also a member of Delta Sigma Rho, the national forensic honorary. Lloyd sings in the Lutheran Church Choir and is a student organist at Anabel Taylor Chapel. He was classical musical director of WVBR-FM during his junior year and program director in his senior year. Lloyd is presently on the "Committee for the 1961 Arts Festival" and is a member of Tau Beta Pi national engineering honorary.

Gregory Okafor, right, a Nigerian student at Cornell University, prepares a sample of Nigerian soil for tests of strength and water absorption. A Master of Science degree candidate, he is conducting research on preparing soils for roadbed under Nigerian conditions. Assisting him is Barry S. Marrus, Cornell senior in civil engineering from Forest Hills, N. Y.

C. Hadley Smith

ENGINEERING ENROLLMENT INCREASE

Engineering enrollment at Cornell has increased for the first time in three years, Dean Dale R. Corson, has announced.

The increase shows Cornell ahead of the national trend in engineering enrollment which, while still showing a slight decrease, has gone down less than in any year since 1957.

Officials are encouraged by the enrollment figures, which they feel reveal a return to a more normal yearly increase in this area, comparable to increases in other fields. "The recent upward trends in engineering enrollments have represented a swing back to a more normal situation," Dean Corson comments.

At Cornell, the entire enrollment in the College of Engineering has gone up two per cent, while freshman enrollment has jumped ten per cent over last year. This is well ahead of the national figure, which shows an increase of 1.2 per cent in freshman enrollment in the fall of 1960. Total enrollment in engineering throughout the nation has remained at about the same as last year.

Dean Corson says that while Cornell is ahead of the national trend, the University has followed the national pattern rather closely in the past. Cornell's figures may indicate a national increase in engineering enrollment within the next several years.

Two factors, the dean feels, have contributed to the recent downward trends in engineering enrollment. "The launching of the first satellites was followed by a great deal of talk about science, and young people flocked to the physical sciences and to mathematics," he said.

"The satellite accomplishments were really engineering accomplishments, and the emphasis on science was misplaced, in my opinion," Dean Corson said.

Another factor affecting the trends, he says, is that during the recession of 1958 a number of large contracts were cancelled and engineers lost their jobs. "It will be interesting to see," he says, "if the present recession is accompanied by a decrease in engineering enrollments again."

The national engineering enrollment in the fall of 1960 was 240 thousand, according to Office of Education figures. Enrollment in graduate study continues to increase, but not enough to offset the decline in undergraduate registration. The proportion of entering students choosing engineering fell to a new low this year, with only 6.6 per cent of new college students. During 1959–60, 1.6 per cent fewer bachelor's degrees were awarded in this field.

At Cornell, 1,909 undergraduate students are enrolled in engineering, of which 572 are freshmen.

"Opportunities for engineers were never better than at present," Dean Corson says. "There are many jobs, and salaries in the field are excellent."

FOREIGN STUDENT DEVELOPING ROAD SURFACES FOR NIGERIA

A Nigerian student, presently enrolled in the University, is conducting research which is expected to make an immediate and vital contribution to the future of his newly-independent nation.

Gregory Okafor, whose field is transportation engineering, is conducting research connected with the problems of road building in Nigeria, where the clay-like soil and severe wet-dry seasons are factors which hamper construction.

Nigeria, like any growing country, needs adequate transportation and communications facilities if it is to realize its social, economic and technological potential. When Great Britain granted independence last October, Nigeria had already made ambitious plans for the future, including routes for a network of highways connecting all parts of the country.

More and better roads are needed in Nigeria to carry the trucks and machinery of agricul-

ture and industry and provide communications channels within the country and to the outside world.

Speaking of the construction carried on before independence, Mr. Okafor says: "In the past, highways and runways were built in Nigeria only for the moment, for the immediate purpose. Now we are building for the future."

Student Okafor's government, which has extended its first ten-year program of highway building ending last year until 1962, is interested in his work. Mr. Okafor hopes that large-scale construction can utilize the results of his work at Cornell. In addition, his findings will be of interest to other tropical countries facing the same problems.

His research involves samples of Nigerian soil received last November. Since then he has examined and analyzed them for mineral content, compaction, wet and dry strength and porosity. Progress has also been made in classifying tropical soil types.

Running a series of tests of strength and water absorption of soil mixtures is his next step in searching for an additive or combination of chemicals which will decrease the amount of cement necessary to improve the soils for highways. He is conducting control tests with cement alone, then with tar, and finally with tar and cement together in various amounts, under one hundred percent humidity and at a temperature of eighty degrees Fahrenheit.

Various faculty members have aided him in his research. His work has been directed by Ta Laing, associate professor of transportation engineering; Prof. Taylor D. Lewis, head of the Department of Transportation Engineering, is his advisor.

After receiving his master of science degree in June, he will return to Nigeria—his first return home in six years—to report on his investigations and conduct more cost research, probably with the Department of Public Works. Mr. Okafor, from Issele-Uku, received his bachelor of science degree in civil engineering from Howard University in 1959. He is president of the Cornell African Students Association.

UPPER CLASS COUNSELORS FOR FRESHMEN

A student organization in the College of Engineering has inaugurated a new program under which upperclassmen will act as voluntary counselors to one or two engineering freshmen apiece.

The project is based on favorable results from a pilot study by the Engineering Student Council in the first term of the 1960–61 academic year. The purpose of the pilot study—in which each Council member assisted one freshman detected as having difficulty—was to help freshmen to adjust to the rigors of engineering study and to college environment.

Often, Dean Dale R. Corson explained, problems arising from such factors as the stress of the transition to college life or the inability to study correctly produce academic difficulty in students who really have the talent to do good work.

It is to help these students that the full scale program is being initiated. Each counselor will meet with the freshmen assigned to him as often as necessary to give help on matters ranging from proper study habits to actual tutoring.

Of 14 students helped in the pilot study two left the College of Engineering, three had averages in the 60's and nine were in the 70's. The result, Dean Corson said, was gratifying because all were heading for grade averages under 70—had they not been assisted.

Selection of upperclass counselors will begin this spring from third and fourth year students of the College of Engineering in the top half of their classes. The counselors will be selected on the basis of interviews, as well as their grades. The selected upperclassmen will be oriented this spring and actual counseling will be undertaken in the fall 1961 term.

The College of Engineering staff is helping the Engineering Student Council launch the program and will continue to encourage the Council's work. Members of the administration at the College will give the prospective counselors advice in the spring orientation meetings and will continue to exchange information with the counseling group.

TECHNIBRIEFS

Edited by Mary Ellen Bertoni Arts '61

NEW DISPLAY DEVICE UTILIZES PIEZO-ELECTROLUMINESCENCE

A new piezoelectric-electroluminescence display device uses an electronic panel less than one-half inch thick that utilizes a new principle to produce a moving lighted image. The panel is composed of an electronic or "piezoelectric" ceramic material, one surface of which is coated with a layer of electroluminescent material. When pulsed voltage is applied to several electrodes on the edges of the flat piezoelectric panel, traveling acoustical waves are introduced into the ceramic material. Electric fields which accompany these acoustical waves interact with the electroluminescent layer to produce a "spot" of illumination on the panel. The position of the "spot" is controlled by varying the relative timing of the electrical pulses to produce an electronic wave pattern. The light intensity of the "spot" is modulated by an electric field applied to a transparent conductive layer covering the electroluminescent layer.

As suitably timed input signals are applied, a series of light spots or lines are produced which can form an image. By varying the timing of the impulses, the image can be made to move about the panel. In certain applications, only a dot of light will be required. Therefore, nonlinear resistance material can be included in the panel to eliminate background light, leaving only the desired display.

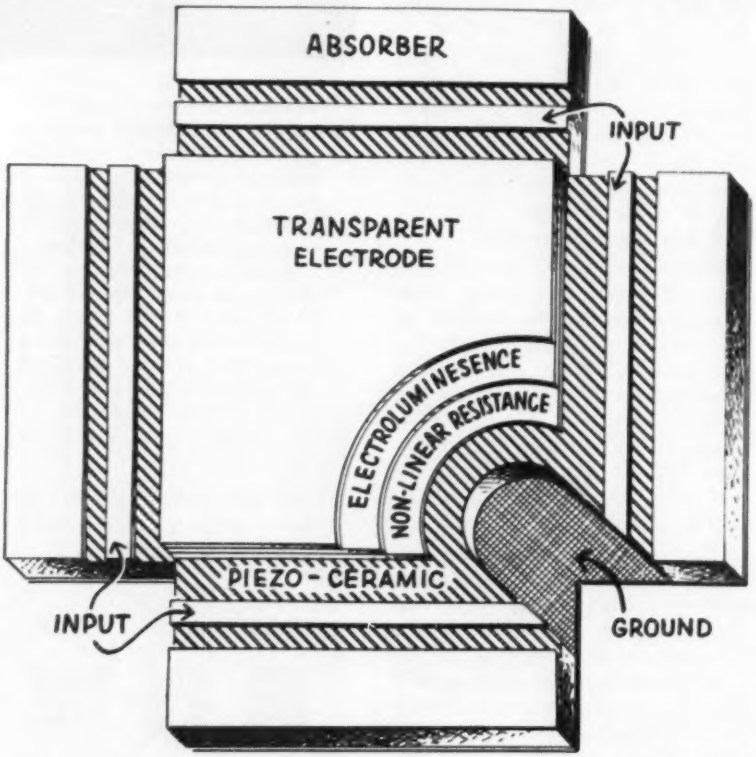
In its present stage, the device, it was said, appears to have its earliest potential use in military and laboratory devices where the production of illuminated lines and dots is needed in electronic systems and equipment.

COOL LIGHT BRIGHTER THAN SUN

Pure, cool and intense light from a ruby crystal about the same size and shape as a regular cigarette has been transmitted over a distance of 25 miles. This device is called a laser (light amplification by stimulated emission of radiation). Because the unique device can be used in present studies of light modulation, one is being constructed by a group under Professor D. F. Holshouser of the Department of Electrical Engineering of the University of Illinois.

The laser, originally suggested by researchers at Columbia University and first realized at Hughes Laboratories, produces light that differs from ordinary incandescent and fluorescent light. The laser's light is coherent: the emitted particles of light, photons, have waves which are synchronized with each other. This results in much greater intensity. The light emerging from the laser is confined to a very narrow beam, spreading so slightly that the beam can be detected at great distances. It has been estimated that a four inch lens used in conjunction with the laser could be used to beam a detectable light signal to the moon. In addition, the laser's coherent light is cool rather than hot. Unlike hot bodies, the laser's radiation may be confined to a very narrow spectrum of visible light. Although the laser's light is cool, it has been estimated that the sun would have to be a million times hotter than it is at present to match the laser's brightness at a given frequency.

Basically, the operation of the laser involves exciting atoms to a higher energy level from which energy is reradiated in a narrow band of frequencies. Although a knowledge of the complex field of modern solid-state physics and familiarity with the quantum mechanics picture of matter and radiation are necessary to fully understand the laser's secrets, the device is simple in its physical structure. For example, a laser built at the Bell Telephone Laboratories consists of a synthetic ruby rod whose flat, highly polished ends are silvered and whose sides are left open to admit the exciting radiation. The ruby rod is held in the center of a spiral photoflash lamp



General Telephone & Electronics Corp.

A schematic diagram of the construction of the piezoelectric-electroluminescence display device.

that lights the ruby with an intense flash of ordinary white light. When the power applied to the photoflash lamp reaches a certain value, a beam of red light is emitted through the ruby's silvered ends. It is the special nature of this emitted light that currently intrigues researchers.

Because its highly directional beam can be focused to pinpoint sharpness, the laser shows great promise in space communication and navigation. Beamed to satellites and other space vehicles, it may become possible for laser signals to carry more information with less power than present radio signals. Current lasers, however, are limited for communications because they emit their light in short bursts rather than in smooth pulses. But this limitation may not be a shortcoming to other application in the fields of atomic physics, astronomy, and medicine. The short bursts of light may possibly be modulated to carry much more information than is now possible. If modulation is achieved, it will be possible to have many telephone conversations or television signals transmitted simultaneously over a special kind of communications network—a "light" network!

The U. of I. laser will be used primarily to aid current studies of light modulation being sponsored by the Air Force Office of Scientific Research.

THERMOELECTRIC POWERED AIR-CONDITIONED SUIT

A self-contained air-conditioned suit which can keep the wearer comfortable in outside temperatures ranging from 40 degrees below zero to 135 degrees Fahrenheit has been developed by scientists of the Westinghouse Electric Corporation and the U.S. Naval Supply Research and Development Facility.

Heating or cooling of the experimental garment is done by thermoelectricity—a refrigeration technique that eliminates the need for conventional moving apparatus. Cooling is accomplished simply by passing a direct current through thermoelectric couples made of semiconductor materials. Reversing the current causes the materials to heat instead of cool. The heating or cooling is done automatically, and a temperature of about 30 degrees F is maintained inside the garment.

Completely airtight, the suit is made of an insulated aluminum-coated fabric. Air for breathing is supplied through a face mask connected to the side of the suit helmet, where incoming air is heated or cooled by a small heat exchanger.

During cooling, the current flow through the elements causes one end of the thermoelectric couples to cool, thus lowering the temperature of the heat exchanger on the inside of the suit. The heat removed from the cool side flows through the thermoelectric elements to the hot-side heat exchanger, from which it is dumped to the atmosphere by a small fan. Another fan, mounted on the same shaft, circulates the cool air within the suit. During heating of the garment, the functions of the two heat exchangers are reversed.

The only moving parts in the suit's entire air conditioning system are the two small fans which circulate and distribute the conditioned air around the wearer. Batteries permit the suit to be independent of any other power source for one hour.

Benson J. Simon

Informal talk in Straight Browsing Library precedes visit.

Benson J. Simon

Fred Hoyle examines Mr. Simon's projector.

SCIENTISTS VISIT *ENGINEER* OFFICE TO SEE LAND COLOR PHENOMENA

by Benson J. Simon, B&PA '62

Four world-famous scientists, including celebrated British astronomer-cosmologist Dr. Fred Hoyle, recently visited the *Engineer* office for a demonstration of the color perception discoveries of Dr. Edwin Land (see "New Theories of Color Perception," *Cornell Engineer*, May 1960). Besides Hoyle, who was delivering last term's Messenger Lectures, the group included Dr. Arnulf Schlüter of the Max Planck Institute for Physics and Astrophysics in West Germany, Carl McIlwain, co-worker of Dr. James Van Allen in space radiation studies, and Prof. Thomas Gold, Chairman of the Astronomy Department and Director of the Center for Radiophysics and Space Research at Cornell. Bicolor projector designed by this reporter was used for the demonstration. It projects fully colored pictures from pairs of filtered monochromatic slides. More sophisticated optical system has since been installed in the device.

Benson J. Simon

Schluter, here to lecture on magnetohydrodynamics, poses question. Hoyle family is at right.

Benson J. Simon

McIlwain, Schluter, Gold, and Hoyle discuss color perception article in May '60 *Engineer*.

Sibley School of Mechanical Engineering

Class of 1961

★ ★ ★ ★

1. Harrison, Richard M. 2. Skilton, Harry I. 3. Romley, Victor H. 4. Hatch, Stephen W. 5. Smith, Drew C. 6. Hill, Cortland P. Professor H. J. Loberg 7. Hays, George F. 8. Aydelott, John C. 9. Watkins, Brian J. 10. Frei, Donald F. 11. Hoar, Thomas C. 12. Van Fleet, James L. 13. Mittleman, Herbert 14. Jew, Marshall 15. Schmitt, Donald B. 16. Lippert, Alan 17. Bleustein, Jeffrey 18. Jacobs, Arnold S. 19. Cipolla, Emil T. 20. Berry, Kenneth E. 21. Penny, Herbert R. 22. White, Francis S. 23. McAfoos, Lawrence R. 24. Cordy, John 25. Santisi, Leonard 26. Mendell, Lawrence W. 27 Perry, Raymond S. 28. Aninger, Robert H. Jr. 29. Dietrich, Lawrence W. 30. Bevilaqua, Louis A. 31. Clark, Earl C. 32. Watkins, William M. 33. Sutton, John D. 34. Bowman, Roy G. 35. Rose, Allen 36. Keen, Richard A. 37. Knowles, Cyrus P. 38. Steeker, William G. 39. Szabronski, Henry G. 40. Smallwood, William L. 41. Liss, Arthur S. 42. Guenzer, Philip J. 43. Geib, Philip J. Jr. 44. Mellowes, John A. 45. Neuberger, John S. 46. Dawson, David M.

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47. Hawks, Charles 48. Bernier, Gerald L. 49. Bevan, Robert 50. Obermeyer, Ronald W. 51. Conadd, Bennett A. Professor H. J. Loberg 52. Filer, Burt K. III 53. Rogers, Cephas B. 54. Kelly, Robert 55. Bauer, Douglas 56. Leonor, Raymundo C. 57. Thatcher, Richard W. Jr. 58. Crabbe, Daniel C. M. 59. Simpson, George 60. Duff, William S. 61. Winfield, Richard A. 62. Ward, John P. 63. McDermott, Robert 64. Platt, Philip L. 65. Wagoner, Robert V. Jr. 66. Fetterlof, John K. 67. Hax, John H. Jr. 68. Hai, Richard B. 69. Picking, Howard 70. Kelliher, Timothy J. 71. Diehl, Slayden 72. Will, Brian R. 73. Maurer, David P. 74. Paulson, Richard H. Jr. 75. Waterfall, John C.

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School of Electrical Engineering

Class of 1961

1. Accardo, Salvatore F. 2. Gilliland, Gene M. 3. Kulka, Robert A. 4. Sargent, David S. North, William D. 6. Drapeau, Raoul E. Prof. True McLean Prof. W. H. Erickson 7. Stein, Michael A. 8. Carson, Richard S. 9. Stiel, Lester 10. Angela, Marciano 11. Mungkandi, Wiwat 12. Mizuno, Elmer T. 13. Ahl, David 14. Belden, Gail Jr. 15. Saunders, Bruce W. 16. Davis, Robert E. 17. Moutoux, Thomas J. 18. Wichman, William M. 19. Eisner, Neil A. 20. Meier, Duncan L, III 21. Pindell, Stuart M. 22. Fraser, James B. 23. Kaplan, Herbert M. 24. Deetz, David R. 25. Rosing, Steven F. 26. Bird, Horace C. Jr. 27. Esses, David J. 28. Rea, Fred G. 29. Ford, Michael A. 30. Craft, Harold D. 31. Banta, Robert 32. Rowan, Douglas M. 33. Williams, Robert M. 34. Ferri, Paul 35. Cryer, Robert R. 36. Macomber, Marshall A. 37. Vollbrecht, John R. 38. Hosterman, Richard N. 39. Bernstein, Sidney M. 40. Lucha, Gerald V. 41. Gintz, William C. 42. Waag, Robert C. 43. Johnson, Richard E. 44. Marmaros, Stephen J. 45. Johnson, Roy D. 46. Weiss, Richard 47. Uhler, Douglas 48. Parks, Thomas W. 49. Rosenthal, Lawrence 50. Wieters, John R. 51. Tribuno, Robert F. 52. Beine, George E. 53. Berkeley, David A.

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Department of Engineering Physics

Class of 1961

1. Cooper, William W. 2. Grannis, Paul D. 3. Prof. T. R. Cuykendall 4. Prof. D. D. Clark 5. Prof. H. F. Newhall 6. Nobel, Park S. 7. Roach, W. Donald 8. Prof. B. M. Siegel 9. Cowell, Gary K. 10. Luft, Philip E. 11. Birnbaum, David 12. Gore, Bryan F. 13. Brau, Charles A. 14. Fogelson, Stephen A. 15. Prof. H. S. Sack 16. Prof. T. N. Rhodin 17. Saperstone, Stephen H. 18 Gifft, Thomas H. 19. Malstrom, Lloyd D. 20. Pinnow, Douglass A. 21. Schubert, Gerald 22. Howard, Stanley G. 23. Harris, Erik P. 24. Huband, Frank L. 25. Dixon, William T. Jr. 26. Friedman, William A. 27. Iwan, Lawrence A. 28. Burget, John E. 29. Riddiford, Alan W. 30. Terdiman, Joseph F.

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FIFTY YEARS AGO IN THE ENGINEER

Edited by Steven J. Whitman EE '64

In a recent address under the auspices of the Tau Beta Pi Society, Mr. F. W. Taylor, a former president of the A. S. M. E. brought out the fact that it is not always the brilliant man who is the best success but rather the man of more ordinary ability with sterling qualities and solid character. . . . In speaking of the value of a college education, it was shown by Mr. Taylor that because a non-college man may often go ahead of the college trained man it does not show that such a training is useless. It is easy to find untrained men with grit and determination equal to yours. Your college training, however, will help you to do just the little extra things for your employer that will mean success.

—Cornell Civil Engineer; May, 1911

Human Engineering is a new profession called into being by conditions in the industrial world. This profession bears the same name as a publication, and seemingly has to do with the human side of industry and the conservation of human energy.

—Sibley Journal; May, 1911

A new course in mining engineering will be established at Cornell next term. The course, which will include not only theoretical but also practical summer work in mining districts, will be under the supervision of four departments: C. E., M. E., Chemistry, and Geology. . . . The course should prove a success, filling a long felt need, as evidenced by the demands from time to time for its establishment.

—Cornell Civil Engineer; June, 1911

The New York Dock Problem has been temporarily settled by the granting of a permit by the United States Government for the extension of the piers of the International Mercantile Marine Company on each side of one of its slips. This will permit ships like the "Olympic" and "Titanic" to go alongside the dock with none of the stern protruding into the North River channel in an unprotected manner, but the permit does not contemplate permanent extension. It is expressly provided that the additions made to the piers shall be of a temporary character which will be allowed to remain in place at the discretion of the Secretary of War. On his order they must be removed immediately.

The final solution of the difficulty of docking big ships is still to be found, and while a number of plans have been presented, there has been no definite scheme formed. All of the interests in New York and New Jersey involved in transatlantic commerce realize that the time is coming when permanent docks for the great ocean ships must be provided, and they are bending their efforts toward the formulation of a plan that will meet all needs and be acceptable to all other interests.

—Sibley Journal; May, 1911

The annual upperclass boat ride for civil engineers, given by the junior class of the college was held on May 17. The venerable "Horton" conveyed the joyous throng safely to Taughannock, where a program of festivities had been arranged. All classes had been suspended by faculty consent and everyone aided in making the boat ride the best C. E. event of the year. An exciting ball game between the seniors and juniors furnished much amusement, although no one knows who won it. . . . .

—Cornell Civil Engineer; June, 1911

One of the most successful banquets ever held by the local branch of the American Institute of Electrical Engineers was held in the library of Sibley Dome on May 25th. The affair was a decided success. As is customary at the Institute banquets, various ingenious electrical surprises were sprung on those present. Upon entering, one passed between two Christmas trees placed so close together as to necessitate brushing against them. Minute electric sparks on the shoulders from the trees caused every man to start as he passed them. Another electrical feature was the receipt of telegrams from famous dead scientists including Mike Farad and others. The Menu was printed in the Continental telegraphic code for the edification of those but slightly familiar with it. . . .

—Sibley Journal; June, 1911

[So this is how it all started . . .]

A new, 30 horse power Westinghouse Gas Engine and Gas Producer which will be ready for operation by June is being installed by the gas department.

—Sibley Journal; April, 1911

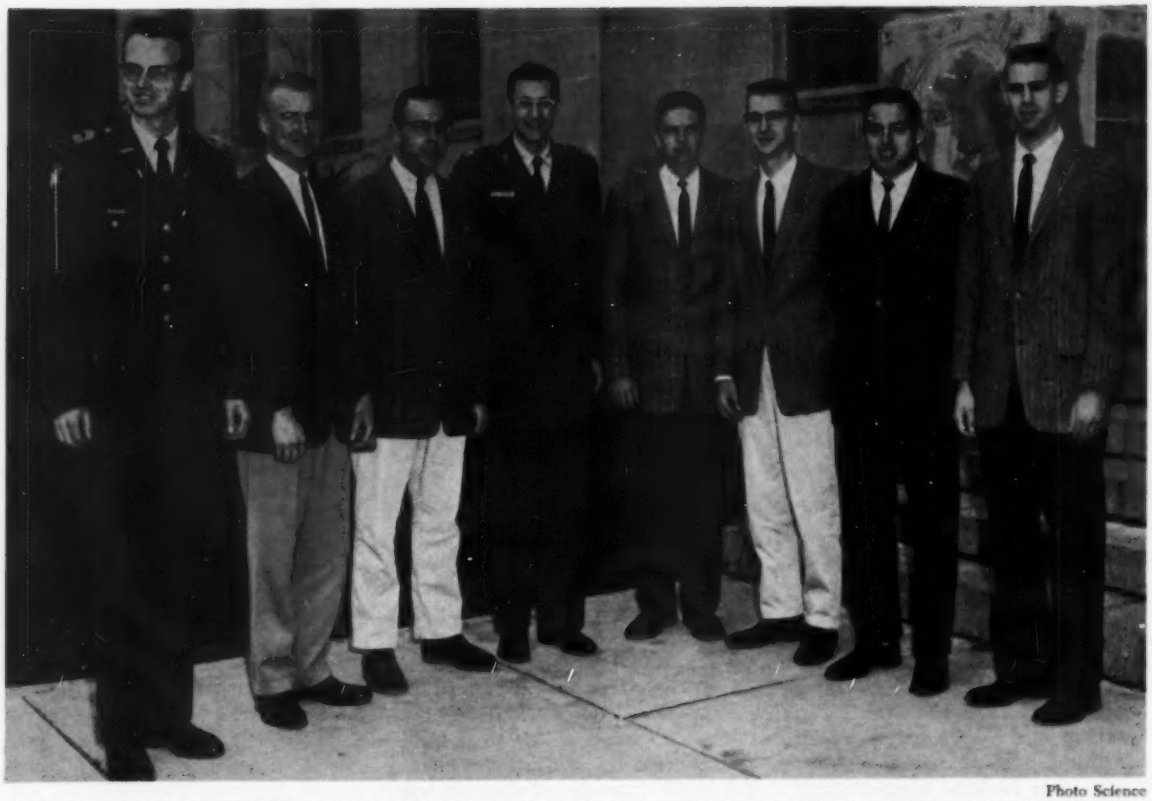

Photo Science

AGRICULTURAL ENGINEERING CLASS OF 1961 Left to Right: George J. Gesslein, Earl A. Hudson, Fred E. Nichols, Bruce D. Gibson, L. Lavern Anstee, Edward J. Race, Bruce L. Davis, Hugh M. Hughes.

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STRESS *and* STRAIN . . .

Edited by Rubert Kaplan EE '64

Here's the ideal perpetual money making machine for those engineers with a little imagination and a will to work at a new and prosperous company with a great future: GLORIOUS OPPORTUNITY TO GET RICH! We are starting a cat ranch in Slaterville Springs with 100,000 cats. Each cat will average 12 kittens a year. The catskins will sell for 30 cents each. One hundred men can skin 5,000 cats a day. We figure a daily profit of over $10,000. Now what shall we feed the cats? We will start a rat ranch next door with one million rats. The rats will breed 12 times faster than the cats. So we will have 4 rats to feed each day to each cat. Now what will we do to feed the rats? We will feed the rats the carcasses of the cats after they have been skinned. NOW GET THIS! We feed the rats to the cats and the cats to the rats and get the skins for nothing!

Those interested may write to the Cornell Engineer, Dead Letter Box, Carpenter Hall.

* * *

Patricia thinks George may
Propose any night now,
Her parents are sure he's the marrying sort,
They're staying up evenings and burning a light low,
Awaiting Patricia and her
Whether report.

* * *

There are just eight reasons why a woman buys something: Because her husband says she can have it, because it will make her look thin, because it comes from Paris, because the neighbors can't afford it, because nobody has one, because everybody has one, because it's different, and just because.

* * *

Watching the hefty duffer ripping up the turf with tremendous swings, two ants became worried. As another mighty blow just missed them, one of the ants said: "Let's get onto the ball before this guy murders us!"

If they make these cars any smaller, the time may come when the pedestrian will be able to hit back.

* * *

Definition from Engineering Handbook: Co-existence; the relationship between the farmer and his turkeys before Thanksgiving.

* * *

When a secretary for a local Congressman phoned the research office of the Library of Congress and asked for an account of "The economic progress of the United States from colonial times to the present," a voice quickly replied: "I'm very happy to inform you that you have the wrong number."

* * *

For the utmost in casual dining, the familiar gadget known as the Lazy Susan is now electrically powered—new name is the "Lazier Susan."

Father teaching his young son arithmetic: "Now, if A earns $75, and B spends $100. . . . you'd better see your mother about this, it's right down her alley!"

* * *

Modern youngster: "My father's car is smaller than your father's car!"

* * *

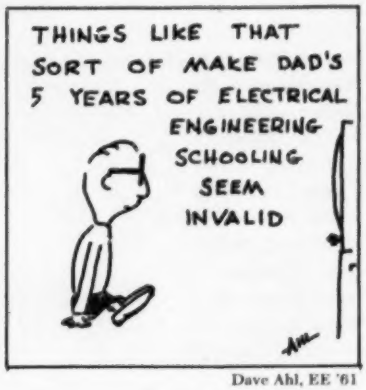
An internal revenue man is writing a book entitled: "How We Made $1,000,000 Off the Fellow Who Wrote The Book About Making $2 Million in the Stock Market."

* * *

One reason why Americans won't go Communist is that when they hear the cry: "Workers arise!", they think it's time for a coffee break.

* * *

Coach to football players: ". . . and men, while this school doesn't overemphasize sports, the alumni do . . ."



Dave Ahl, EE '61

If your sights are set on research and development–

Jet heat blast of more than 15,000 degrees Fahrenheit flares over surface of an experimental nose cone shape in a physics laboratory of Avco Research and Advanced Development Division, Wilmington, Mass.

–you'll find **Photography at Work** with you

RESEARCH and development engineers find photography one of their most versatile tools. Camera and film can record the readings of instruments—can capture for study the fleeting transient on the oscilloscope face. The content and structure of metals can be studied by photospectrography or x-ray diffraction. And stresses in parts are visualized by photographing plastic models with transmitted polarized light.

There's hardly a field on which you can set your sights where photography does not play a part in simplifying work and routine. It saves time and costs in research, on the production line, in the engineering and sales departments, in the office.

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TRADE MARK

One of a series

Interview with General Electric's

Francis J. Boucher

Manager-Manufacturing Personnel Development Service

How Good Is Your Best Job Offer . . .

Q. Mr. Boucher, with all the job interviews a graduating engineer goes through, how can he be reasonably sure he has made the right choice?

A. This is a good question because few seniors have enough work experience in industry, government and educational institutions to allow them to make a fully reasoned choice. However, I think the first step is to be sure that short-term factors like starting salary and location don't outweigh long-range factors like opportunity and professional growth. All of these factors should be evaluated *before making a final commitment.*

Q. But you do feel that starting salary is important?

A. Very much so. If you are married—it may be an even greater consideration. But you should also look beyond starting salary. Find out, for example, if the company you are considering has a good salary administration plan. If there is no way of *formally* appraising your performance and determining your appropriate rewards, you run the risk of becoming dissatisfied or stalemated due to neglect of these important considerations.

Q. What considerations do you feel should be evaluated in reaching a job decision?

A. Let me refer you to a paper written by Dr. L. E. Saline, now Manager of Information Systems in our Defense Systems Department. It is titled "How to Evaluate Job Offers." (Incidentally, you may obtain a copy by writing as directed in the last paragraph.) In it, Dr. Saline proposes six questions—the answers to which should give you much of the information you'll need for an objective job-offer evaluation. He suggests you determine . . .

- to what degree will the work be challenging and satisfying?
- what opportunities are available to further develop abilities?
- what opportunities are there for advancing in the Company (and how dynamic the Company is in the marketplace is an important aspect of this question).
- what salary potentials are possible with respect to the future?
- what about geographical location —now and in the future?
- what effort does the Company make to establish and maintain a professional climate?

There is more to these questions than meets the eye and I think you would enjoy reading Dr. Saline's paper.

Q. What about the openings on defense projects that are listed in the various magazines and newspapers?

A. Presumably, there will always be a need for technical manpower in the defense business. But I want to point out to you that most of these opportunities are for experienced personnel, or personnel with specific additional training received at the graduate level.

Q. How do you feel about training programs? Do they offer any particular advantages over any other offer I might accept?

A. I feel training programs are particularly helpful in easing the transition from an academic to a business environment. Of course they provide formal training designed to add to the individual's basic fund of knowledge. They also provide working experience in a variety of fields and a broad knowledge of the company concerned and its scope of operations. Upon completion, the individual is generally better prepared to decide the direction in which he will pursue his professional career.

General Electric conducts a number of training programs. Those that attract the greatest number of engineers are the Engineering and Science, Manufacturing, and Technical Marketing Programs. Each combines a formal, graduate-level study curriculum, on-the-job experience, and rotating assignments. There is little question in my mind that when an engineer completes the Program of his choice, he is far better prepared to choose his field by interest and by capability. I might also add that because of this, he is more valuable to the Company as an employee.

Q. Then you feel that a training program is the best alternative for a graduating engineer?

A. Not always. Some seniors have already determined the specific field they are best suited for in terms of their own interests and capabilities. In such cases, direct placement into this specific field may be more advantageous. Professional self-development for these employees, as for all General Electric technical employees, is encouraged through a variety of programs including the Company's Tuition Refund Program for work toward advanced degrees, in-plant courses conducted at the graduate level, and others designed to meet individual needs.

Q. For the record, how would you rate a job offer from General Electric?

A. I've tried to get across the need for factual information and a long-range outlook as the keys to any good job evaluation. With respect to the General Electric Company, seniors and placement offices have access to a wide variety of information about the Company, its professional environment and its personnel practices. I think qualified seniors will also discover that General Electric offers professional opportunity second to none—and starting salaries that are competitive with the average offered throughout industry today. From the above, you can see that I would rate a job offer from General Electric very highly.

Want more information about General Electric's training programs? You can get it, together with a copy of Dr. Saline's paper "How to Evaluate Job Offers" by writing to "Personalized Career Planning," General Electric Company, Section 959-15, Schenectady 5, New York.

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